CLAIMS

1. A method of forming macroscopic cavities within the body of a silicon element comprising the steps of:

(a) providing a p-doped silicon element having a front surface and a back surface;

(b) forming a plurality of pits in the front surface of the silicon element;

(c) providing a patterned electrode in electrical contact with the silicon element within discrete regions of said back surface; and

(d) maintaining the front surface of the silicon element and a counter-electrode in contact with an electrolyte, the silicon element having a positive potential with respect to the counter-electrode, while maintaining an electrochemical current density between the silicon element and the counter-electrode.

2. A method as claimed in claim 1 wherein said electrolyte is an aqueous electrolyte.

3. A method as claimed in claim 2 wherein said aqueous electrolyte includes fluoride ions and has a pH of about 1 to about 7.

4. A method as claimed in claim 3 wherein said aqueous electrolyte has a fluoride concentration of about 0.25 to about 5 M.

5. A method as claimed in claim 3 wherein said aqueous electrolyte includes an acid other than HF and a fluoride salt.

6. A method as claimed in claim 5 wherein said fluoride salt is selected from the group consisting of fluoroborate salts.

7. A method as claimed in claim 5 wherein said fluoride salt is $NH_4F$.

8. A method as claimed in claim 3 wherein said electrolyte includes HCl and $NH_4F$.

9. A method as claimed in claim 3 wherein said aqueous electrolyte includes a surfactant.

10. A method as claimed in claim 1 wherein said electrolyte is a non-aqueous electrolyte.

11. A method as claimed in claim 10 wherein said non-aqueous electrolyte includes less than about 100 parts per million water by weight.

12. A method as claimed in claim 1 wherein said plurality of pits are formed at preselected locations on said front surface and at least some of said discrete regions are aligned with at least some of said plurality of pits.

13. A method as claimed in claim 12 wherein said step of forming said plurality of pits includes the step of forming a layer of a silicon oxide or silicon nitride on said front surface, forming openings in said layer at said preselected locations, and anisotropically etching the silicon in said element through said openings.

14. A method as claimed in claim 1 wherein said pits taper from a relatively wide area at said front surface to a relatively narrow area beneath said front surface.

15. A method as claimed in claim 1 wherein said step of providing a patterned electrode on the back surface of the silicon element comprises forming a layer of a silicon oxide or silicon nitride on said back surface, forming openings in said layer within said discrete regions, and metallizing said back surface.

16. A method as claimed in claim 15 wherein said step of providing a patterned electrode includes implanting boron beneath said back surface within said discrete regions.

17. The method of claim 1 wherein said initial positive potential is between +5 volts and +25 volts.

18. The method of claim 1 wherein said electrochemical current density is maintained between 0.05 and 0.9 amps/$cm^2$ of surface area of said front surface.

19. The method of claim 1 wherein said electrochemical current density is maintained between 0.2 and 0.6 amps/$cm^2$ of surface area of said front surface.

20. The method of claim 1 wherein said electrochemical current density is maintained at about 0.4 amps/$cm^2$ of surface area of said front surface.

21. A method of forming a macroscopic cavity within the body of a silicon element comprising the steps of:

(a) providing a p-doped silicon element having a front surface and a back surface;

(b) forming at least one pit in the front surface of the silicon element;

(c) providing an electrode in electrical contact with the silicon element within at least one discrete region of said back surface; and

(d) maintaining the front surface of the silicon element and a counter-electrode in contact with an electrolyte, the silicon element having a positive potential with respect to the counter-electrode, while maintaining an electrochemical current density between the silicon element and the counter-electrode.

22. A method as claimed in claim 21 wherein said at least one pit is formed at at least one preselected location on said front surface and at least one of said at least one discrete region is aligned with said at least one pit.

23. A method as claimed in claim 22 wherein said step of forming said at least one pit includes the step of forming a layer of a silicon oxide or silicon nitride on said front surface, forming at least one opening in said layer at said preselected location, and anistropically etching the silicon in said element through said at least one opening.

24. A method as claimed in claim 21 wherein said step of providing said electrode on the back surface of the

silicon element comprises forming a layer of a silicon oxide or silicon nitride on said back surface, forming at least one opening in said layer within said discrete region, and metallizing said back surface.

25. A method as claimed in claim 24 wherein said step of providing said electrode includes implanting boron beneath said back surface within said discrete region.

26. A p-doped monocrystalline silicon body having a front surface, a rear surface, a plurality of macroscopic cavities within said body and a layer of crystalline silicon adjacent to said front surface, said layer of crystalline silicon overlying at least some of said plurality of macroscopic cavities, said macroscopic cavities and said layer of crystalline silicon being formed by an electrochemical etching process, said process comprising the steps of:

(a) providing said p-doped silicon body;

(b) forming a plurality of pits in the front surface of the silicon body;

(c) providing a patterned electrode in electrical contact with the silicon element within discrete regions of said back surface; and

(d) maintaining the front surface of the silicon element and a counter-electrode in contact with an electrolyte, the silicon element having a positive potential with respect to the counter-electrode, while maintaining an electrochemical current density between the silicon element and the counter-electrode.

27. The p-doped monocrystalline silicon body of claim 26 wherein said plurality of pits are formed at preselected locations on said front surface and at least some of said discrete regions are aligned with at least some of said plurality of pits.

28. A p-doped monocrystalline silicon body having a front surface, a rear surface, at least one macroscopic cavity within said body and a layer of crystalline silicon

adjacent to said front surface, said layer of crystalline silicon overlying at least one macroscopic cavity, said at least one macroscopic cavity and said layer of crystalline silicon being formed by an electrochemical etching process, said process comprising the steps of:

(a) providing said p-doped silicon body;

(b) forming at least one pit in the front surface of the silicon body;

(c) providing an electrode in electrical contact with the silicon element within at least one discrete region of said back surface; and

(d) maintaining the front surface of the silicon element and a counter-electrode in contact with an electrolyte, the silicon element having a positive potential with respect to the counter-electrode, while maintaining an electrochemical current density between the silicon element and the counter-electrode.

29. The p-doped monocrystalline silicon body of claim 28 wherein said at least one pit is formed at at least one preselected location on said front surface and said at least one discrete region is aligned with said at least one pit.

30. A p-doped monocrystalline silicon body having a front surface, a plurality of macroscopic cavities within said body, a layer of crystalline silicon adjacent to said front surface, said layer of crystalline silicon overlying at least some of said cavities, and a plurality of openings within said front surface, each cavity of said plurality of macroscopic cavities being in communication with said front surface by means of at least one of said plurality of openings.

31. The p-doped monocrystalline silicon body of claim 30 wherein said layer of crystalline silicon has a substantially uniform thickness throughout the planar area of said layer overlying said at least some of said cavities, said thickness being the distance from said front surface to

a surface of said layer exposed to said at least some of said cavities.

32. The p-doped monocrystalline body of claim 31 wherein said thickness of said crystalline silicon layer is substantially the same as a width of said opening in said front surface, said width being the distance from one side of said opening to an opposed side of said opening in the plane of said front surface.

33. The p-doped monocrystalline silicon body of claim 30 wherein, within at least a part of said body, said plurality of macroscopic cavities occupy an aggregate planar area comprising at least 50% of the planar area of said front surface.

34. The p-doped monocrystalline silicon body of claim 33 wherein, within said at least a part of said body, said plurality of macroscopic cavities occupy an aggregate planar area comprising at least 90% of the planar area of said front surface.

35. The p-doped monocrystalline silicon body of claim 30 wherein said silicon body has a back surface and at least one of said plurality of macroscopic cavities has a front wall proximate to said layer of crystalline silicon, a back wall opposed to said front wall of said at least one of said plurality of cavities, and a side wall that separates said at least one of said plurality of macroscopic cavities from at least one other of said plurality of macroscopic cavities, said back surface of said at least one of said plurality of cavities being closed with respect to said back surface of said silicon body and said side wall being closed with respect to said at least one other of said plurality of cavities.

36. The p-doped monocrystalline body of claim 35 wherein said back wall of said at least one of said plurality of macroscopic cavities has a pyramidal shape.

37. A p-doped monocrystalline silicon body having a front surface, at least one macroscopic cavity within said

body and a layer of crystalline silicon adjacent to said front surface, said layer of crystalline silicon overlying said at least one cavity, and at least one opening within said front surface, said at least one cavity being in communication with said front surface by means of said at least one opening.

38. The p-doped monocrystalline silicon body of claim 37 wherein said layer of crystalline silicon has a substantially uniform thickness throughout the planar area of said layer overlying said at least one cavity, said thickness being the distance from said front surface to a surface of said layer exposed to said at least one cavity.

39. The p-doped monocrystalline body of claim 38 wherein said thickness of said crystalline silicon layer is substantially the same as a width of said at least one opening in said front surface, said width being the distance from one side of said opening to an opposed side of said opening in the plane of said front surface.

40. The p-doped monocrystalline silicon body of claim 37 wherein, within at least a part of said body, said at least one macroscopic cavity occupies an aggregate planar area comprising at least 50% of the planar area of said front surface.

41. The p-doped monocrystalline silicon body of claim 40 wherein, within at least a part of said body, said at least one macroscopic cavity occupies an aggregate planar area comprising at least 90% of the planar area of said front surface.